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SAM Table Dataset for Four Municipalities of China (2012, 2015)

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Abstract: The Computable General Equilibrium (CGE) model is one of the important research methods in economics. In recent years, it has been applied widely in the fields of tariff, trade barriers, resources, and environment. The CGE model data come from the Social Accounting Matrix (SAM), which is based on an input-output table. However, most input-output tables are only prepared at national and provincial levels, which is not conducive to the study of urban problems using the CGE model. This paper, based on input-output theory, matches 41 industrial sectors in China to five types of state-owned construction land, including land for transport, in the first-level classification of landuse status. According to the latest input-output table, in combination with the "Land and Resources of China Yearbook", "Beijing Statistical Yearbook", "Shanghai Statistical Yearbook", "Tianjin Statistical Yearbook", "Chongqing Statistical Yearbook", and the Beijing, Shanghai, Tianjin, and Chongqing Social Accounting Matrix (SAM) in 2012–2015 are compiled and balanced using the direct cross-entropy method. This dataset can provide data support for the construction of an urban land use CGE model, and the study of urban land use and urban economics.

Keywords: CGE model; Social Accounting Matrix; urban economics; municipalities of China

1 Introduction

The economist Wassily Leontief proposed the input-output model, also known as the Leontief model, which uses simultaneous linear equations to accurately describe the interrelationship and interaction between economy and technology in various sectors of the national economy[1]. The input-output method has greatly promoted and influenced the development of modern economics. The full name of the CGE Model is the Computable General Equilibrium Model; it involves the deepening and development of input-output analysis. The traditional input-output model only analyzes intermediate products/intermediate inputs, factor inputs, final products, and other links without considering the economic activities of residents, enterprises, governments, and other sectors, as well as social and economic accounts such as savings, investments, imports, and exports. Therefore, its role has certain limitations[1]. According to Walras' general equilibrium idea[2], the price variable is solved, and the analysis result is more comprehensive and systematic. Therefore, the CGE Model has played a huge role in international trade, government taxation, resources and environment, public policy, and other fields, and has been widely applied, gradually becoming an important tool in modern economic research[1].

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CGE model data are derived from the Social Accounting Matrix (SAM). It reflects the relationship between capital flow and proportion among various sectors of the social economy, and describes social and economic activities in a more detailed way. Only municipalities directly under the central government and provincial-level administrative regions in China compile input-output tables at every mantissa of 2, 7 years, with a preparation interval of 5 years. To keep the data updated, the input-output extension table is prepared for every year with mantissa 0 and 5. The input-output extension table updates the data based on the input-output table. The department classification is completely consistent with the input-output table, and the data are extendable. However, the data are derived from statistical data, rather than from a direct survey, like the data in the input-output table. Therefore, the input-output extension table is consistent with the input-output table, and both can be used together. Since the National Bureau of Statistics has not yet compiled the input-output table for the municipalities directly under the central government in 2017, the latest input-output table for the Chongqing municipality was the input-output extension table for 2015. Therefore, a SAM table for Chongqing in 2015 was compiled by taking Beijing, Tianjin, Shanghai, and Chongqing as examples and SAM tables for Beijing, Tianjin, Shanghai, and Chongqing in 2012 according to relevant data.

2 Metadata of the Dataset

The metadata of "SAM table dataset for four municipalities of China (2012, 2015)"[3] is summarized displayed in Table 1.

Table 1 Metadata summary of "SAM table dataset for four municipalities of China (2012, 2015)"

Items	Discription
Dataset full name	SAM table dataset for four municipalities of China (2012, 2015)
Dataset short name	SAM_4MunicipalitiesChina
Authors	Zhang, Y. 0000-0002-1633-2478, Hunan University of Finance and Economics, 520andylau@sina.com
Geographical region	Beijing, Tianjin, Shanghai, Chongqing
Year	2012–2015 Data format .xlsx Data size 25.2 KB
Data files	6 .xlsx worksheets: (1) SAM for Beijing in 2012; (2) SAM for Shanghai in 2012; (3) SAM for Tianjin in 2012; (4) SAM for Chongqing in 2012; (5) SAM for Chongqing in 2015; (6) Code, meaning, and unit in SAM
Foundation	Hunan Education Department (18C0964)
Data publisher	Global Change Research Data Publishing and Repository, http://www.geodoi.ac.cn
Address	No. 11A, Datun Road, Chaoyang District, Beijing 100101, China
Data sharing policy	***Data*** from the Global Change Research Data Publishing & Repository includes metadata, datasets (data products), and publications (in this case, in the *Journal of Global Change Data & Discovery*). ***Data*** sharing policy includes: (1) ***Data*** are openly available and can be free downloaded via the Internet; (2) End users are encouraged to use ***Data*** subject to citation; (3) Users, who are by definition also value-added service providers, are welcome to redistribute ***Data*** subject to written permission from the GCdataPR Editorial Office and the issuance of a ***Data*** redistribution license; and (4) If ***Data*** are used to compile new datasets, the 'ten percent principal' should be followed such that ***Data*** records utilized should not surpass 10% of the new dataset contents, while sources should be clearly noted in suitable places in the new dataset[4]
Communication and searchable system	DOI, DCI, CSCD, WDS/ISC, GEOSS, China GEOSS, Crossref

3 Methodology

3.1 Definitions of Elements

The 10 elements in SAM table include industrial and mining warehousing, transportation, housing, commercial services, public administration, labor, capital, land, residents, and government. The corresponding relationship between industrial land types and input-output departments is shown in Table 2.

Table 2 Comparison of land use types and input-output departments in China

Land use types	Definition of land use types	Corresponding sections of IO table
Land for industry, mining, and warehousing	This refers to the land mainly used for industrial production and warehousing	Mining and washing of coal products Extraction of petroleum and natural gas products Mining and processing of metal ores products Mining and processing of non-metal ores products Food and tobacco Textiles Clothing, hats, leather, feather, and related products Processing of timber products and furniture Paper, printing, culture, education, and sport products Products of petroleum, coking, and processing of nuclear fuel Chemical products Products of non-metallic minerals Products of metals smelting and pressing Metal products General equipment Special equipment Transportation equipment Electrical machinery and apparatus Communication, computers and other electronic equipment Measuring instruments Other manufactured products Waste and flotsam Repair services of metal products, machinery, and equipment Electric power and heat production and supply Gas production and supply Water production and supply Construction
Land for transport	This refers to the land mainly used for ground lines and stations for transportation and passage. It includes land used for civil airports, harbors, wharves, ground transport pipelines, and all types of roads	Transport, storage, and post
Land for residential uses	This refers to the land used for house sites and the affiliated facilities for people's daily life and dwelling	Real estate
Land for commercial and services uses	This refers to land mainly used for commerce and service use	Wholesale and retail trades Hotel and catering services Information transmission, software, and information technology Financial intermediation Leasing and business services
Land for public management and public services	This refers to the land mainly used for government agencies and public organizations, press and publication, science, education, culture and health, scenic spots, historical sites, and public facilities	Scientific research and technical services Management of water conservancy, environment, and public Facilities Services to households, repair, and other services Education Health and social work Culture, sports and entertainment Public management, social security and social organization

Similar to the input-output table, the SAM table is a matrix with rows and columns equal to each other, and the same rows and columns correspond to a sector in the national economy. Where the production/activity sector reflects the relationship between intermediate demand and intermediate input among industrial sectors, it can be divided into two departments of production and activity, or one department can be combined as needed. As shown in Table 3, to simplify the analysis, the two departments of production and activity should be merged into the production/activity department.

Table 3 Components of the SAM table

Item	Production/activities	Production factors	Households	Government	Total
Production/activities	Intermediate input/Use Part		Household consumption	Government consumption	
Production factors	Value-added				Factor income
Households		Resident factor income			Total resident income
Government			Individual income tax		Total government revenue
Total	Total inputs	Factor expenditure	Household spending	Government consumption	

It can be found that the 42 industrial sectors analyzed by input-output analysis in China basically correspond to five types of state-owned construction land, such as transportation land, industrial and mining land, and storage land, in the classification of land use status in China[5] (Table 2). According to the division of construction land and the definition of the industry in the land classification, five industries, including information transmission, software, and information technology services in the input-output table can correspond to commercial service land. 27 industries were compared with industrial and mining storage land. Seven industries, including scientific research and technical services, water conservancy, environment, and public facilities management, will be matched with public management and public service land. The real estate industry could be matched with residential land. 42 sections in the table have some overlapping fields, so it cannot fully correspond to the classification of land use status, such as the classification of warehousing. Since the warehousing industry and the transportation industry are merged into the transport, storage and post industry (code 30) in the input-output table of China, they cannot be separated. Here, warehousing industry refers to goods transportation, transit warehousing, and goods distribution mainly engaged in warehousing. Its main business belongs to the same category as transportation, so the transportation and storage industry were matched with transportation land. The special land in the state-owned construction land includes the land for military facilities, embassies, and consulates; the water area and water conservancy facilities in the construction land include the water surface of reservoirs, coastal beaches, and other land including idle land. Taking Beijing as an example, in 2012, the special land, water and water conservancy facilities land, and other land in Beijing were 3.33, 6.83, and 0 hm^2, respectively[6], which accounted for a small proportion and were not closely related to the city's social economy, so they were not included in the research scope. Since this dataset is mainly used to study the structure of urban construction land, the data for agriculture, forestry, animal husbandry, fishery, and corresponding agricultural land data in the input-output table are excluded. Other departments[1] and match the standard CGE model, including elements, residents, government, and summary departments.

3.2 Statistical Approach

According to the above analysis, the original data in the input-output table for Beijing, Shanghai, Tianjin, and Chongqing municipality[7–10] in 2012 and the input-output extension table for Chongqing[9] in 2015 were first combined horizontally and vertically according to the classification of departments in Table 2, and then the other data in the SAM table were supplemented according to the statistical yearbook of each city. Data on land for industry, mining, warehousing, transport, residential uses, commercial and services uses, public management and public services of Beijing, Shanghai, and Tianjin in 2012 and Chongqing in 2012 and 2015 come from the references[6,11]; data on value added for SAM come from the IO table for Beijing, Shanghai, and Tianjin in 2012 and Chongqing in 2012 and 2015[7–10,12]; data on resident factor income for SAM come from the "People's life and

price" section in the "Beijing statistical yearbook," the "Shanghai statistical yearbook," the "Tianjin statistical yearbook" for 2013, and the "Chongqing statistical yearbook" for 2013 and 2016[13–17]; data on Household Consumption and Government Consumption of SAM come from the IO table for Beijing, Shanghai, and Tianjin in 2012 and Chongqing in 2012 and 2015[7–10,12]; data on individual income tax for SAM come from the "Government finance" section in the "Beijing statistical yearbook", the "Shanghai statistical yearbook," the "Tianjin statistical yearbook" for 2013 and the "Chongqing statistical yearbook" for 2013 and 2016[13–17].

At the same time, similar to the input-output table, the total number for each column of the SAM table is equal to the total number for each row, thereby achieving "balance" in the SAM table. However, primary SAM tables are not balanced in the usual sense, so they need to be balanced in different ways. The cross-entropy method is a more balanced method adopted in the modern CGE model, including a direct cross-entropy method and a coefficient cross-entropy method, in which the coefficient the cross-entropy method is mainly used to update the existing SAM table data. Therefore, to retain the idea of economics and overcome its subjectivity, this dataset is adopted to balance the SAM table with a direct cross-entropy method as the primary method and a manual balance method as the supplement. The cross-entropy method builds the model according to the entropy information proposed by information economics, and its objective function is:

$$\min_{X_{ij}} z = \frac{1}{H}\sum_{j}^{n}\sum_{i}^{n} Q_{ij} \log\frac{Q_{ij}}{\overline{Q_{ij}}} - \log\frac{H}{\overline{H}} \tag{1}$$

$$H = \sum_{j}^{n}\sum_{i}^{n} Q_{ij}\ ,\quad \overline{H} = \sum_{j}^{n}\sum_{i}^{n} \overline{Q_{ij}}\ ,\quad s.t.\sum_{i}^{n} Q_{ik} = \sum_{j}^{n} Q_{kj} \tag{2}$$

where $\overline{Q_{ij}}$ is the original data of the SAM table. Q_{ij} is the balanced data, and all are positive.

4 Data Files

The files consist of one Excel file with six worksheets, respectively: (1) SAM for Beijing in 2012; (2) SAM for Shanghai in 2012; (3) SAM for Tianjin in 2012; (4) SAM for Chongqing in 2012; (5) SAM for Chongqing in 2015; (6) Code, meaning, and unit in SAM. The dataset is archived in .xlsx format and consists of one file with a data volume of 25.2 KB.

5 Discussion and Conclusion

The SAM table is not only the basic data of the CGE model but also a further development of the input-output table. Based on the input-output table, government, savings-investment, import and export, and other departments and modules are added to reflect the capital flow and proportion relationship between various sectors of the social economy and describe social and economic activities in a more detailed way.

Taking the SAM table for Beijing as an example, the general equilibrium analysis analyzes the changes in prices and the total amount for various factors such as GDP increase, labor force, capital and land, and predicts the impact on various sectors of Beijing's economy and society, to make more accurate policy evaluations and adjustments. For example, when GDP increased by 6.5%, land prices rose 20% and the total labor force increased by 20%. The SAM table data was input to GAMS (general algebraic modeling system) software, to set up a corresponding CGE model.

With economic development, the structure of new construction land in Beijing changed significantly under three scenarios (Table 4), including a steady increase in GDP, a rising price for land, and a significant increase in labor supply caused by the two-child policy.

Table 4 Structural changes in optimal construction land in Beijing under three scenarios

Item	Industry, mining, and warehousing		Transport		Residential		Commerce and services		Public management and services	
	Area (km^2)	Change (%)	Area (km^2)	Change (%)	Area (km^2)	Change (%)	Area (km^2)	Change (%)	Area (km^2)	Change (%)
Actual value	5.31	–	0.33	–	6.14	–	1.49	–	3.00	–
Scenario 1	0.03	–99.48	24.42	7,398.97	86.26	1,305.85	0.01	–99.08	28.82	861.16
Scenario 2	0.48	–90.88	0.66	103.22	5.78	–5.88	0.15	–90.25	0.21	–92.85
Scenario 3	0.38	–92.87	0.62	89.89	5.02	–18.17	0.12	–92.13	0.18	–94.06

When GDP is expected to grow steadily by 6.5%, the supply of land for transport, residential use, public management, and public services should be effectively increased compared to the actual value. When the price of land increases by 20%, due to the apparent increase in land use cost, in addition to land for transport, the approval and supply of land for industry, mining and warehousing, residential uses, commercial and services uses, public management, and public services should be strictly controlled. When the total labor force is expected to increase by 20%, the simulation results are similar to Scenario 2. Therefore, the preparation of a SAM table for Beijing, Shanghai, Tianjin, and Chongqing, using the CGE model, is conducive to a more comprehensive and in-depth analysis of the social and economic problems of each municipality directly under the central government.

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